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# Anxiety and Its Impact on Memory

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Abstract

From influences on our memories of common words to even eyewitness testimonies, anxiety can shape our view of the world (Amir et al., 1996). Our research attempted to show a relationship between anxiety and its effects as an impact on memory as is supported by the Theory of Attentional Control (Eysenck & Calvo, 1992). A video from Simons' and Chabris' (1999) study on Inattentional Blindness was used to assess whether anxiety is adaptive or maladaptive to functions of our memory. Our study did not find significance regarding the impact of anxiety on memory. However, the relevance and interest of studies on memory and arousal continues to escalate through the years.

*Key Words*: Anxiety, Memory, Adaptive.

# Anxiety and Its Impact on Memory

Anxiety has long proven to have an enormous impact on our day-to-day lives and even in life-threatening circumstances. It stands to reason that anxious arousal itself could have a negative impact on our memory, especially under stressful circumstances. Across time, psychological research suggests that no one variable is independent from one another, especially arousal and cognitive functions such as memory. One study by researchers' Beuzen and Belzung (1994) suggests that there is a precise link between emotional memory and the state of anxiety a person is in. They wished to clarify the difference that state and trait anxiety has on memory. Beuzen and Belzung (1994) measured the relationship between memory and anxiety states by the use of the passive avoidance test. Further research using principal component analysis indicated that emotional memory is in fact linked to state anxiety (defined as anxiety in the face of threatening demands) (Beuzen & Belzung, 1994). Our experiment is based on the Theory of Attentional Control, which states that our attention can only be directed to stimuli that is relevant to our current aims (Eysenck & Calvo, 1992). Simons' and Chabris' (1999) iconic study on inattentional blindness shows support for this theory through its remarkable results. The results of a brief questionnaire showed that the likelihood of noticing objects that are unexpected for a specific environment depends on how alike the object is to other stimuli surrounding the environment (Simons' & Chabris', 1999). Our research built on the findings of this study, and we used the original video with the stimulus of the primate from this study as well as the questionnaire for our materials. Our focus was on the question of if anxiety promotes more adaptive memory with unexpected situations in our environments or if it inhibits the recall of events.

In the growing field of Cognitive Psychology, there is a growing amount of support for the Theory of Attentional Control. This can be seen in work by researchers Amir et al. (1996), which showed that individuals who experienced more arousal performed negatively on color-naming threat-related tasks than non-threat-related tasks in an Emotional Stroop Test. So, with more anxious arousal present, people tended to do poorer on the task. More evidence for this theory comes from researchers' Wessel & Merckelbach (1997), on spider phobia. The study follows the theory, stating that physiological arousal results in attention being directed toward central characteristics of the event (Wessel & Merckelbach (1997). Spider phobias were presented with a large spider stimulus and then given a memory test designed to test the experimental situation; the results provided some support for the theory (Wessl & Merckelbach, 1997). Researchers' Shackman, Sarinopoulos, & Maxwell (2006) studied whether anxiety impacted visuospatial working memory. A series of experiments suggested that individuals characterized by higher behavioral inhibition exhibited more intense anxiety and poorer spatial memory on measures given (Shackman, Sarinopoulos, & Maxwell, 2006). A classic piece of evidence supporting the Theory of Attentional Control is the Deese-Roediger-McDermott Paradigm (Watson McDermott, & Balota, 2004). This ground-breaking study provided evidence for false memories, and how maladaptive anxiety can have an impact on individuals' cognitions. In this rendition of the famous study, five trials were observed where individuals both young and old were told to memorize a list of 600 words (Watson et al., 2004). Half of the participants were given a hint about the nature of the DRM paradigm while the other half of the participants were not. The results of the study showed that without a warning the probability of verbal recall increased across all trials and age groups but the probability for false verbal recall of words decreased for younger adults only (Watson et al., 2004). The findings of the DRM paradigm

suggest that arousal inhibits our memory processes more than we realize. A study by Zare & Ghorbani (2016) found supporting results which compared the effects of both positive and negatively induced false memory compared with the anxiety and depression symptoms of individuals. Twenty-nine individuals with depression and anxiety symptoms were selected in the experimental group and twenty-nine individuals without symptoms were chosen in the control group (Zare & Ghorbani, 2016). Following this, a false memory test was given to both groups, and then both groups were assessed by mood tests.. The results of the study showed that positive and negative mood coupled with anxiety and depression may cause an increase in false memories (Zare & Ghorbani, 2016). Researchers' Vaandermaas, Hess, & Baker-Ward (1993) conducted a study on the effects of anxiety on children's memory of a natural stressful event. Anxiety was assessed by a behavior ranking scale and eighty children from ages 4-8, visited the dentist as a stress-inducing experience. Results showed that all measures of anxiety were significantly associated with one another, and future research was encouraged on the complex relationship of anxiety and memory (Vaandermaas, Hess, & Baker-Ward (1993). If the theory of Attentional Control was to be supported in our research, then the results would show that anxiety inhibits people's memory and function in the events entirety because our focus is restricted.

In contrast, the Experiential Theory of Emotion by researchers Greenberg et al (1990)., states that anxiety is adaptive under the right stimuli and situations (although it is important to note that this research does not take maladaptive anxiety into consideration). This research was done in numerous trials across a variety of different cultures, and the results showed that emotions can make you decisive and in peril at the same time. Additional support for this theory includes research by Robinson et al., on the impact of anxiety on arousal by using threat of shock (Robinson, Vytal, Cornwell, & Grillon, 2013). The research defined anxiety as distinctly

different from fear, with anxiety being a response to an ongoing and unpredictable threat that creates numerous changes. An interesting phenomenon that supports the Experiential Theory of Emotion is the development of false memories and their relationship with arousal, and research by Deese-Roediger-McDermott (Wenzel et al., 2004). This study by Wenzel et al., (2004) applied the False Memory Paradigm in order to examine whether anxious individuals showed evidence of higher recall than less anxious individuals. Two trials were used in this study; in study one approximately 108 individuals learned four-word lists that were related to target words that were to make participants anxious including “spider” and “blood” (Wenzel et al., 2004). In the second group, a social threat was involved in the unpresented target words and they were asked to memorize four lists of neutral target words. The results of this study provided evidence to support of the Experiential Theory of Control because both groups one and two showed no difference in their ability to recall falsely remembered words (Wenzel et al., 2004). If the Experiential Theory of Emotion were to be supported by our research, then it would provide more evidence that under extreme threats and conditions when our memory is tested, anxiety will be adaptive to our performance.

Our research attempted to show a relationship between anxiety and its effects as an impact on memory. The hypothesis for this experiment was that there would have been a significant difference in the test scores of people with more arousal than those with less arousal because of an impact on concentration levels, supporting the Attentional Control Theory. Specifically, if someone scores high on the anxiety scale, then they will score poorly on the questionnaire. By the addition of another component to their work, hopefully more evidence will be able to be provided on the impact of anxiety on memory and overall cognitive function.

## Method

### Participants

Coastal Carolina University students with a psychology major over 18 years old were recruited from introductory psychology classes exclusively. The main method of recruitment was from SONA systems, an online research platform. The specific age range for participants was approximately 18-24 years of age. Participants were compensated for their time with online credit to fulfill a requirement for psychology 101 courses. Per thirty-minute interval of time spent on a student, students received roughly half a point of course credit. We collected data from twenty-nine Coastal Carolina students ($M_{age}$= 18.86, age range: 16-22 years old). All data was collected online, and we had no personal contact with the participants. Prior to being the study, participants were encouraged to perform the tasks associated with the study in a quiet environment.

### Materials

The first task assigned to the participants within the experiment was to watch the video labeled Selective Attention Test (Simons & Chabris, 1999). This task was based on and then adapted for anxiety arousal from Simons & Chabris iconic study of Inattentional Blindness. It showed a short ten to twelve second video of a ball exchanging hands and a gorilla as a distraction in the background. We shortened the original video to cut out the end expectations from the participants to heighten the impact of the stimuli. A short six question survey on the topics of the video was given. Questions such as, “While you were counting, did you notice anything unusual within the video?”, or “Did you notice anything other than the six players?” was included in the survey. The final survey that was be given is labeled the Cognitive and Somatic Anxiety Scale, also known as the CSAQ (Schwartz, Davidson, & Daniel, 1978).

Originally crafted by Schwartz et al., the CSAQ was designed from three well-known questionnaires and is a dual component scale. It uses a Likert-type scale with one being not relating at all and four being relating very much. The Likert-type scale asks participants questions such as, “I agonize over my problems” and “I can’t get some thought out of mind” (Schwartz et al., 1978). The higher the scores of the different symptoms of the CSAQ, the more anxious participants are. The CSAQ is meant to measure the amount of anxiety that participants are feeling regarding the impending test on the video they watched. By measuring participant’s anxiety, we could possibly see a relationship on whether anxiety is an inhibitor or if it is adaptive.

**Arousal**

We defined the independent variable of anxiety or arousal as being the body’s natural response to stress, or a feeling of fear for what’s to come (Schwartz et al., 1978). Specific to our study, it is a feeling of uneasiness and apprehension of the impending test on the stimuli viewed in the video. Symptoms of anxiety include but are not limited to: numbness, chest pain, burning skin, shortness of breath, inability to rest, and a nervous stomach. By using the CSAQ, we were able to measure the physiological and psychological symptoms that participants feel based on this variable of arousal (Schwartz et al., 1978). The variable of anxiety or arousal was measured on a twenty-one question, Likert-type scale (1= not at all, and 4= very much so).

**Performance**

We defined one of the dependent variables of performance as being whether they have identified the gorilla in the background or not based on the answers to the questions. The dependent variable was measured by the survey taken from the work of Simons & Chabris (1999). This questionnaire was scored based on a yes or no basis on questions two through six.

**Concentration**

A second dependent variable in this study was concentration. Concentration was defined as being the action of focusing attention or mental faculties on a stimulus. In this specific study, we measured concentration as being whether the participants were able to approximate the number of times the basketball exchanged hands. This question was taken directly from the study on Inattentional Blindness. The first question was scored regarding the amount of times the basketball exchanged hands; the closer it was to the actual number of times the basketball moved; the more attention was placed on the stimuli, thus reflecting in concentration level (Simons & Chabris, 1999).

**Procedure**

Participants had approximately thirty minutes to complete the experiment. Student participants were briefly introduced to the research in the online informed consent document and upon signing it, were told to participate in the experiment in a quiet area free of distractions. The brief video from the study by Simons' & Chabris' (1999) was shown, and participants in the group being manipulated were also told that there would be a short test afterwards. The mentioning of a test was meant to ensure attentiveness and to increase arousal while participants observed the video. After being told of the anonymity of the survey, and to answer as honestly as possible, student participants were able to access the demographic information, Cognitive and Somatic Anxiety Scale, the questionnaire regarding the video by Simons' & Chabris' (Schwartz et al., 1978). At the end of the study, there was a short debriefing message followed by an expression of gratitude for completing the experiment. All participants were encouraged to contact myself, or my faculty advisor Dr. Ryan Yoder for more information (followed by my

contact information). After completion, students were awarded course credit by SONA systems and by the Professor's discretion.

## Results

The control group ($N$=18) that had no mention of a test before the video was associated with equal recorded amounts of anxious arousal and higher test results ($M$=39.67, $SD$=11.38). By comparison, the experimental group ($N$=11) that was given a warning for the test before the video had a $M$= 43.36 and $SD$=12.31.The mean age for participants was 18.86, and the valid frequencies for female participants was ($F$=21) whereas the frequency of valid male participants was ($F$=4). Under 25% of trials from participants were excluded due to errors in participant data, such as failure to answer demographic related questions that could skew the results if included.

To test the original research hypothesis for the control group and the experimental group, an independent samples $t$-test was performed. As can be seen in Table 1, the control group and the experimental group distributions were normal and the test showed no significant difference in the mean arousal rate. In addition to the independent samples $t$-test, a nonparametric Mann-Whitney U test was used to test the null hypothesis to see how likely a random value selected from the control group is to be less than or greater than another selected from the experimental group. The Mann-Whitney U test showed that participants in the control group ($N$=18) had a higher arousal mean rank ($M_R$=14.17) than the experimental group ($N$=11) who had an arousal mean rank of 16.36. On test performance, Mann-Whitney U showed the experimental group as having a higher mean rank ($M_R$= 19.27) than the control group ($M_R$=13.00).

A One-Way ANOVA was performed and the main effect of anxious arousal in test-taking was shown to be non-significant $F(3,28)= .442$, $p> .05$. Therefore, there was not a significant

difference in test performance with and without the arousal variable present. A Point Biserial Correlation representing the relationship between the results of the video questionnaire and arousal rating was ran and results can be seen in Graph 1. Finally, Cronbach's alpha test was used to estimate the reliability of the tests and questionnaires performed by participants. The video questionnaire was found to be moderately reliable (6 items; $\alpha$=.50). The Cognitive and Somatic Anxiety Scale consisted of twenty-one items ($\alpha$= .89) and was found to be highly reliable.

## Discussion

As stated previously, anxiety impacts our daily lives as humans enormously, therefore the relevance of research in this field relating anxiety to other variables of interest is extremely insightful. However, compared to the original findings in Simons' & Chabris' (1999) study on Inattentional Blindness, our experimental research hypothesis stated that there would be a significant relationship between the results of the video questionnaire and the proposed level of arousal for subjects in the experimental variable group. This hypothesis was not supported by the data we collected. In other words, as participants' arousal increased, their performance neither increased nor decreased based on the arousal variable. We based the experiment on the Study of Inattentional Blindness and added the variables of college students and measuring arousal compared to the results of the video experiment. The results suggest that the level of anxious arousal does not predict inattentional blindness to our environment, but that arousal levels differ across age ranges.

The added criteria of anxiety between the control and the experimental groups showed similar scores on the Cognitive and Somatic Anxiety Scale and the video questionnaire. The findings of this study suggest that because of the additional variable of arousal in the form of

test-taking anxiety, the same results did not hold up compared to the original study. Simons' & Chabris' (1999) found that the test results depended on the alikeness of the objects to the environment. Adding on to the findings of the independent sample t-test, a point biserial correlation was run to test the results of the video questionnaire against the arousal ratings of participants. The results showed no significant findings as well.

As for the predictor variables such as age, race, and gender, there were no significant findings suggesting that age impacted the overall performance on the test. Although these findings are inconclusive on the overall statistical significance, they fit with the findings from the original study by Simons' & Chabris' (1999), suggesting that variables such as age may be of little importance to the overall findings. The results of the statistical analysis ran for the variable of class rank against arousal ratings can be seen in Figure 2. Comparing class rank against arousal, there was a noticeable difference in the participant scores on the Cognitive and Somatic Anxiety Questionnaire (CSAQ) for juniors than for freshman, sophomores, and seniors. With the mean arousal rating being highest for juniors compared with the overall findings of the study, the findings may suggest that generally speaking juniors have a higher level of anxiety than others, and the findings could be the cause of a confounding variable that we did not no of i.e., midterms and/or finals.

Although the findings of this research are not statistically significant, we believe there is great relevance in the data from the experiment itself. The original findings of Simons' & Chabris' (1999) work still reigns true: how much we perceive of a certain stimuli very much depends on what we expect in the environment. Our research asked the question of whether a person's arousal level impacted how they perceived their environment, and how likely they would be to notice changes as their arousal peaked. We predicted that as people's arousal levels

increased, their test results (in other words whether they were able to fully perceive their environment) would be impacted. We chose arousal to be perceived as participants believing they were going to be taking a test. Perhaps a higher level of arousal would have produced more similar results as seen in the original study. As for the impact of variables such as age, the absence of statistically significant findings regarding demographic variables (age, gender, race) fits with the findings of the original study. This research narrows down what other causes may be involved in the original study and what may impact it. With arousal not being a factor involved in Inattentional Blindness, it begs the question what other behavioral factors if any may impact the how we take in our environment.

Many groundbreaking studies in the field of psychology have shown that emotions have a strong impact on how we perceive the world around us. In one study by Rocha, Marche, & Baeyer (2009), researchers' examined the effects of temperament and trait anxiety on memory of pain in children. Thirty-six children were assessed between the ages of five and twelve who were undergoing minor procedures, with the children rating their pain. After an eight week time lapse, the same participants were asked about their pain. Results indicated that while most children accurately recalled their pain based on the original rating, children with higher trait-anxiety showed a greater likelihood of recalling more intense pain than they originally reported, suggesting that the arousal may have caused a negative distortion on memory (Rocha, Marche, & Bayer, 2009). In the study by researchers' Gross & Mastenbrook (1980), the influence of state anxiety on memory was researched. By applying problem solving skills, their sample population of college students were asked to solve simple problems without any type of memory aid and some with memory aid. Results of this study suggest that high state-anxious individuals tended to use less of a focused strategy when the use of memory aids were unavailable (Gross &

Mastenbrook, 1980). This research points to the importance of future and past research on the topic of memory related to arousal, and how it impacts college students. In another interesting study by researchers' Civettini & Redlawsk (2009) on how emotions play an impact on the memory for voters at the time of a vote, results indicated that anxiety actually lead to voters remembering more information as opposed to information that was not received in an emotionally charged manner, which supports the second theory from above (Experiential Theory of Emotion). Another classic study of the DRM paradigm suggested that arousal inhibits our memory processes more than we realize (Watson et al., 2004). Finally, Harris & Cumming (2006) studied the relationship between anxiety and performance on retrospective memory tasks. Their research was based on the Processing Efficiency Theory and the results suggested that state anxiety has a direct impact on prospective memory performance (Harris & Cumming, 2006). All of the past work regarding emotions in psychology suggest how much of an impact they have on us as humans, so it only stands to reason that they would have an impact on our interpretation of the environment. By better understanding the level of arousal and type of emotions that elicit these kind of responses, future research may be able to pinpoint how to find the exact ways different emotions interact with how we interpret our surroundings.

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Figure 1

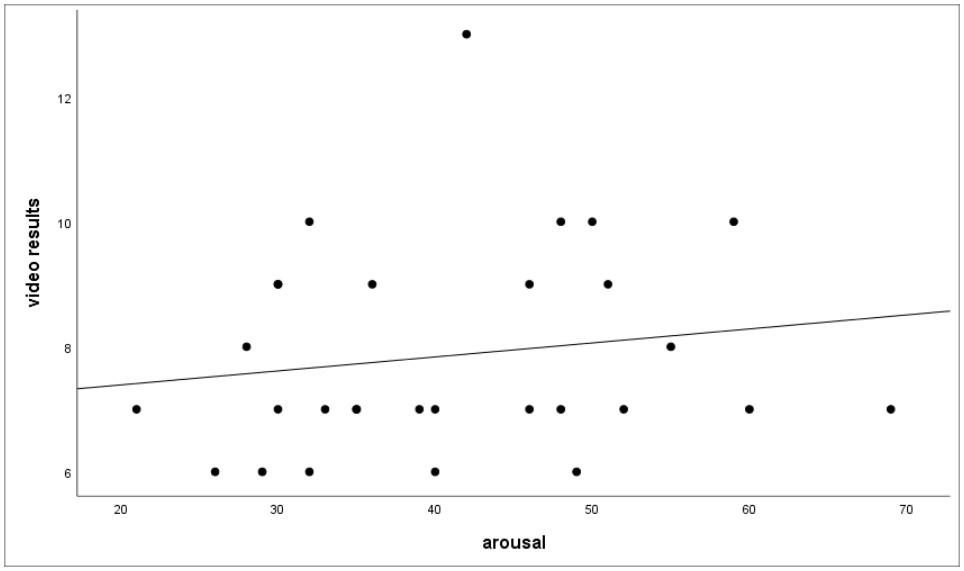


Figure 1: Point Biserial Correlation representing the relationship between the results of the video questionnaire and arousal ratings.

Figure 2

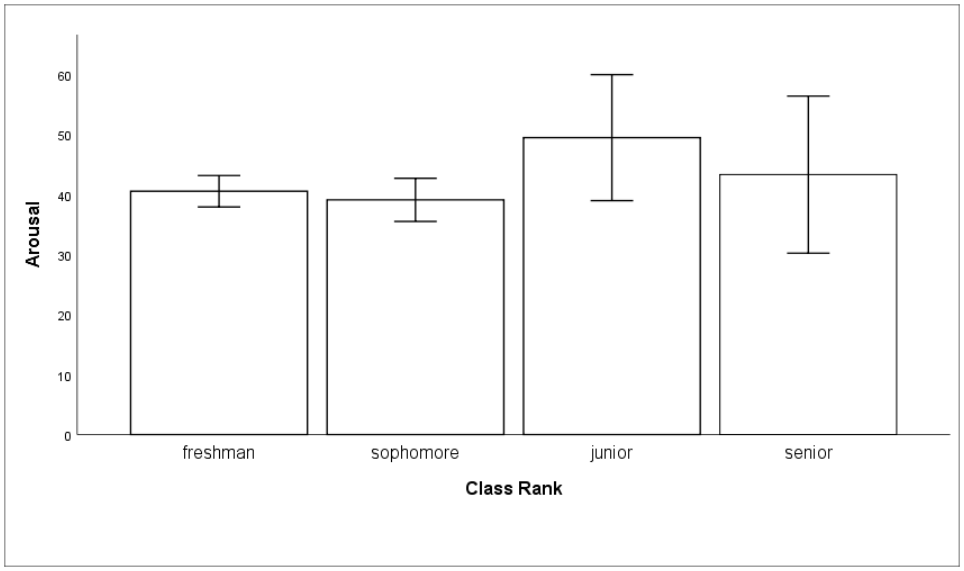


Figure 2: Bar graph comparing arousal and class rank with filter of group variable.

Table 1

| **Group** | **Mean** | **Standard Deviation** |
|---|---|---|
| Experimental | 43.36 | 12.31 |
| Control | 39.67 | 11.38 |
| **Average** | **41.52** | **11.85** |

**Showing the control and experimental group distributions, $t(27)= -0.823$, $p>.05$.*

Appendix A

Demographic Information:

1. Age
2. Gender
    a. Female
    b. Male
3. Class Rank
    c. Freshman
    d. Sophomore
    e. Junior
    f. Senior
4. Race
    g. White
    h. Hispanic
    i. African american
    j. Asian/Pacific Islander
    k. Other

Appendix B

Video Questionnaire

5. While you were doing the counting, did you notice anything unusual on the video
    l. Yes
    m. No
    n. I’m not sure
6. Did you notice anything other than the six players?
    o. Yes
    p. No
    q. I’m not sure
7. Did you see anything other than the six players?
    r. Yes
    s. No
    t. I’m not sure
8. Did you see the gorilla walk across the screen?
    u. Yes
    v. No
    w. I’m not sure
9. Have you ever heard of an experiment like this before?
    x. Yes
    y. No
10. Have you ever participated in an experiment like this before?
    z. Yes

aa. No

Appendix C

Cognitive Somatic Anxiety Scale (CSAQ)

Below is a list of statements which can be used to describe how people feel. Beside each statement are four numbers which indicate how often each statement is true of you (e.g., 1= not at all, 4= very much so). Please read each statement carefully and circle the number which best indicates how often, in general, the statement is true to you:

11. My heart beats fast
12. My muscles are tense
13. I feel like I agonize over my problems
14. I think others won't approve of me
15. I feel like I'm missing out on things
16. I feel dizzy
17. My muscles feel weak
18. I feel trembly and shaky
19. I picture some future misfortune
20. I can't get some thought out of my mind
21. I have trouble remembering things
22. My face feels hot
23. I think that the worse will happen
24. My arms and legs feel stiff
25. My throat feels dry
26. I keep busy to avoid uncomfortable thoughts
27. I cannot concentrate without irrelevant thoughts intruding

28. My breathing is fast and shallow

29. I worry that I cannot control my thoughts

30. I have butterflies in the stomach

31. My palms feel clammy